Comprehensive Site Assessment Workplan

Exxon #2-8329, Upper Crossroads, 2800 Fallston Road, Fallston, MD

1. Purpose

1.1 Groundwater and Environmental Services, Inc. (GES) has prepared this Comprehensive Site Assessment Workplan (CSA) on behalf of ExxonMobil Refining and Supply (ExxonMobil). An evaluation of the hydrogeologic system will be conducted at the Upper Crossroads, Fallston, Maryland site. This CSA is presented to satisfy the requirements identified in the 6 July 2004 Maryland Department of the Environment (MDE) correspondence to ExxonMobil regarding this site. Three distinct phases of investigative methods are proposed. These include: a review of available geologic literature and a non-intrusive area study, an investigation of the unconsolidated or overburden aquifer, and a multi-faceted investigation of the bedrock aquifer. A summary of each of the three investigative phases is presented below to include objectives, proposed methodologies, and pertinent assumptions. The following attributes of this proposed CSA should be noted:

- It is assumed that access to the identified properties can be obtained for the investigative purposes described herein.
- The findings of each completed phase of work will be used to support the development/refinement of a conceptual site model and will also be used as a basis for modification of subsequent investigative tasks.
- Requests to modify the CSA will be made to the MDE as conditions warrant.

In order to meet the deadline proposed for the completion of this investigation, more than one phase of this CSA will be undertaken concurrently as outlined in the proposed execution timeline (Table 1). A description of each of the proposed investigative phases is provided below:

2. Phase I – Non-Intrusive Study

2.1 A review of available geologic publications, maps, and aerial photos for the area will be conducted to describe and to analyze the geologic and hydrogeologic settings at the site. Investigation and structural mapping of local bedrock outcrops will also be completed to identify predominant bedrock features. Tasks will include procurement and review of aerial photos, topographic maps, geologic maps and references and the quantification of predominant bedrock features effecting groundwater flow and dissolved MTBE migration in the study area.

2.2 A limited investigation will be conducted to identify current and former use at properties located up to one mile from the Upper Crossroads Exxon. The purpose is to identify potential petroleum sources and environmental concerns within and near the study area.

2.3 A thorough review of all available supply well completion/construction records will also be completed as part of Phase I. These records are to be supplied by the Harford County Health Department (HCHD). Records will be closely examined to identify total well depths, depth of

well casings, pump settings and qualitative information relative to well yields, fractures and groundwater quality. A field survey will be completed to accurately measure and map the location and elevation of wells within the study area for which access is provided. This survey will incorporate global positioning system (GPS) tools and methods such that a comprehensive and integrated database can be prepared to allow for spatial referencing of site data and the evaluation of trends tying well construction, location or age to chemical results.

2.4 Phase I will also incorporate an analysis of the storm water drainage network in the Upper Crossroads area – to include identification and discussion of surface water bodies and sampling results obtained from each as per Section 4G of the 6 July 2004 MDE letter.

2.5 A three-dimensional visual model of pertinent site and hydrogeologic features will be prepared. This conceptual model will incorporate pertinent physical information obtained during the course of the investigation and will be modified based on additional site data.

3. Phase II – Overburden Investigation

3.1 A surficial geophysical survey consisting of electrical resistivity profiling will be undertaken across three discreet linear transects to the northeast, west and southwest of the Exxon station for the purpose of determining the orientation of the bedrock/overburden interface and shallow fracture patterns within the bedrock. Fracture location and orientation information will be used to site soil borings and monitoring wells in subsequent investigative phases.

3.2 An area-wide subsurface profiling and volatile organic compound (VOC) screening scope of work will be conducted using traditional drilling methods. The profiling will include both shallow and deep monitoring wells.

3.3 Groundwater monitoring wells will be placed in linear arrays to the northeast, west and southwest of the Exxon station to intercept the shallow water table and the highly fractured and weathered "transitional" zone along the top of the competent bedrock surface. Exact well locations will be determined based upon results of the previous investigations as well as logistical limitations (i.e., utilities, surface topography, etc.). Maps indicating the likely proposed locations of monitoring wells are enclosed (Figures 1 and 2). The linear arrangement of these proposed well locations also corresponds to the surficial geophysical array discussed in section 3.1 above. Should subsurface conditions permit, two separate screened intervals will be constructed in a common six-inch diameter well bore to allow for evaluation of potentiometric head and groundwater chemistry from the water table aquifer and from the weathered transitional zone between the overburden and bedrock aquifers. All wells will be surveyed to a common elevation datum, gauged to determine static groundwater elevation and sampled to determine total dissolved VOC concentrations.

Additional plume delineation wells may also be needed. However, based on the current status of the investigation the location where these wells may be needed is uncertain. A submittal with proposed delineation wells will be made at a later date as necessary.

4. Phase III – Bedrock Aquifer Investigation

4.1 Following completion of the well construction analysis and above-described surficial geophysical studies, additional monitoring wells may be installed in areas where data gaps exist or additional site-specific information is desired to evaluate potentiometric head relationships and groundwater flow gradients between the overburden and bedrock aquifers as well as affording an opportunity to discern the chemical attributes of each water-bearing zone independently.

4.2 Down-hole geophysical survey of selected supply wells in the study area will be completed. This down-hole survey will require the removal of the submersible well pumps and well stabilization (approximately one-half day) prior to tool entry. The suite of tools to be deployed will include:

- Acoustical televiewer
- Caliper log
- Natural gamma log
- Electrical resistivity log
- Temperature log

The intent of these well bore analyses is to identify the location and three-dimensional orientation of planar bedrock features within the aquifer (foliation, fractures, joints, etc.), and determine which of these transmit water. A qualified subcontractor will be employed to conduct these down-hole surveys and assist in the interpretation of data. Wells selected for such investigation include supply wells at the following properties:

- Parcel 332, Exxon Service Station #2-8329, 2800 Fallston Road;
- Parcel 244, 2801 Fallston Road;
- Parcel 387, 2500 Greene Road;
- Parcel 386, Corner of Scarff Road and Baldwin Mill Road;
- Parcel 188, 2419 Baldwin Mill Road; and
- Parcel 64, Baldwin Mill Road (approximately 30 lots, currently under development).

Newly installed bedrock wells may also be included.

4.3 Further investigation of identified water-transmitting fractures will be undertaken through down-well packer testing. Inflatable straddle packers will be placed in open-rock wells to isolate identified water bearing zones for slug testing and groundwater sample collection. Wells selected for packer testing may include any of those identified above for geophysical profiling. Slug testing will be completed by pressurizing the selected well interval with compressed air and monitoring the change in corresponding water pressure (potentiometric head). Potentiometric rebound will then be measured with a data logger following the release of the air pressure. The data will be analyzed to estimate the hydraulic conductivity at each water-bearing zone. The data

collected will also be used to estimate groundwater flow velocities. The straddle packers will also allow for the collection of discrete groundwater samples using low-flow purging and sampling methods. Samples will be collected for laboratory analysis of VOCs (to include MTBE) and selected inorganic parameters. These inorganic parameters may include metals, common electron acceptor ions, and other indicators of aquifer chemistry (iron, manganese, magnesium, calcium, nitrate, sulfate, dissolved oxygen, pH, and oxidation-reduction potential).

4.4 A groundwater pumping test will be conducted at the Exxon site to directly measure bedrock and overburden aquifer response to pumping from the bedrock aquifer. A centrally located pumping well will be selected to allow the collection of head loss (drawdown) data in several surrounding onsite and/or offsite monitoring wells. Analysis of the data collected will provide estimates of aquifer hydraulic conductivity.

5. Phase IV – Data Summary and Reporting

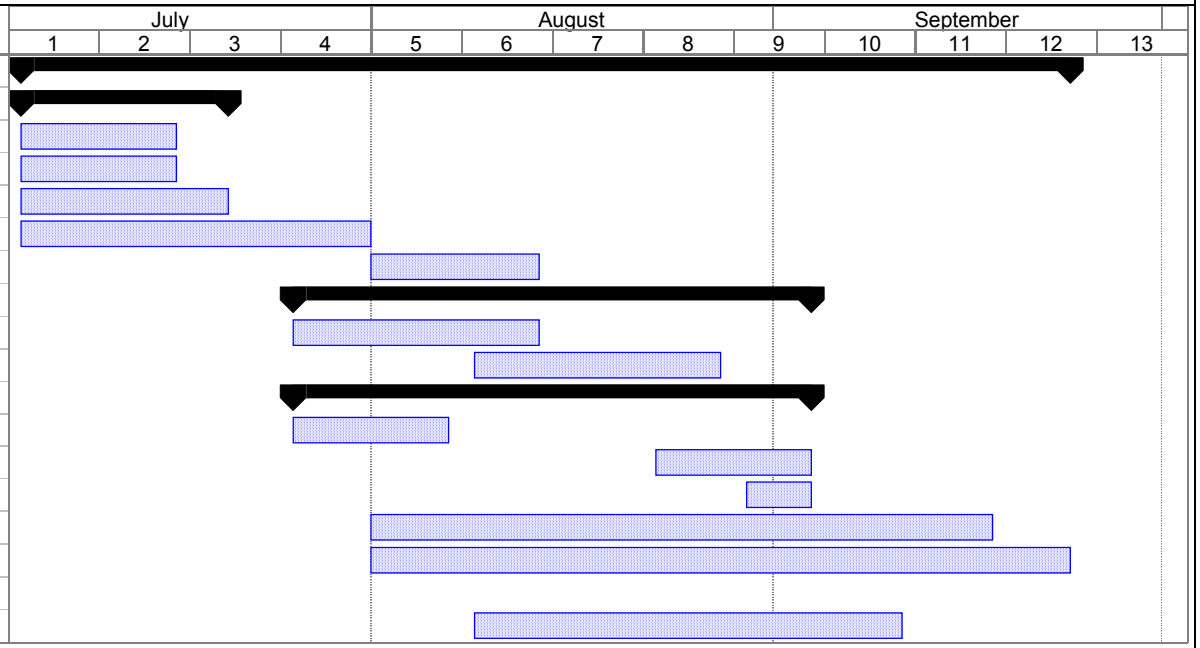
5.1 Three-dimensional evaluation of the structural, chemical and hydraulic properties of the bedrock aquifer will be undertaken via statistical analysis to evaluate MTBE transport pathways. Statistical tools employed may include tri-linear chemistry plots, equal area projections of planar features and compass rose density plots of prevalent structural attributes.

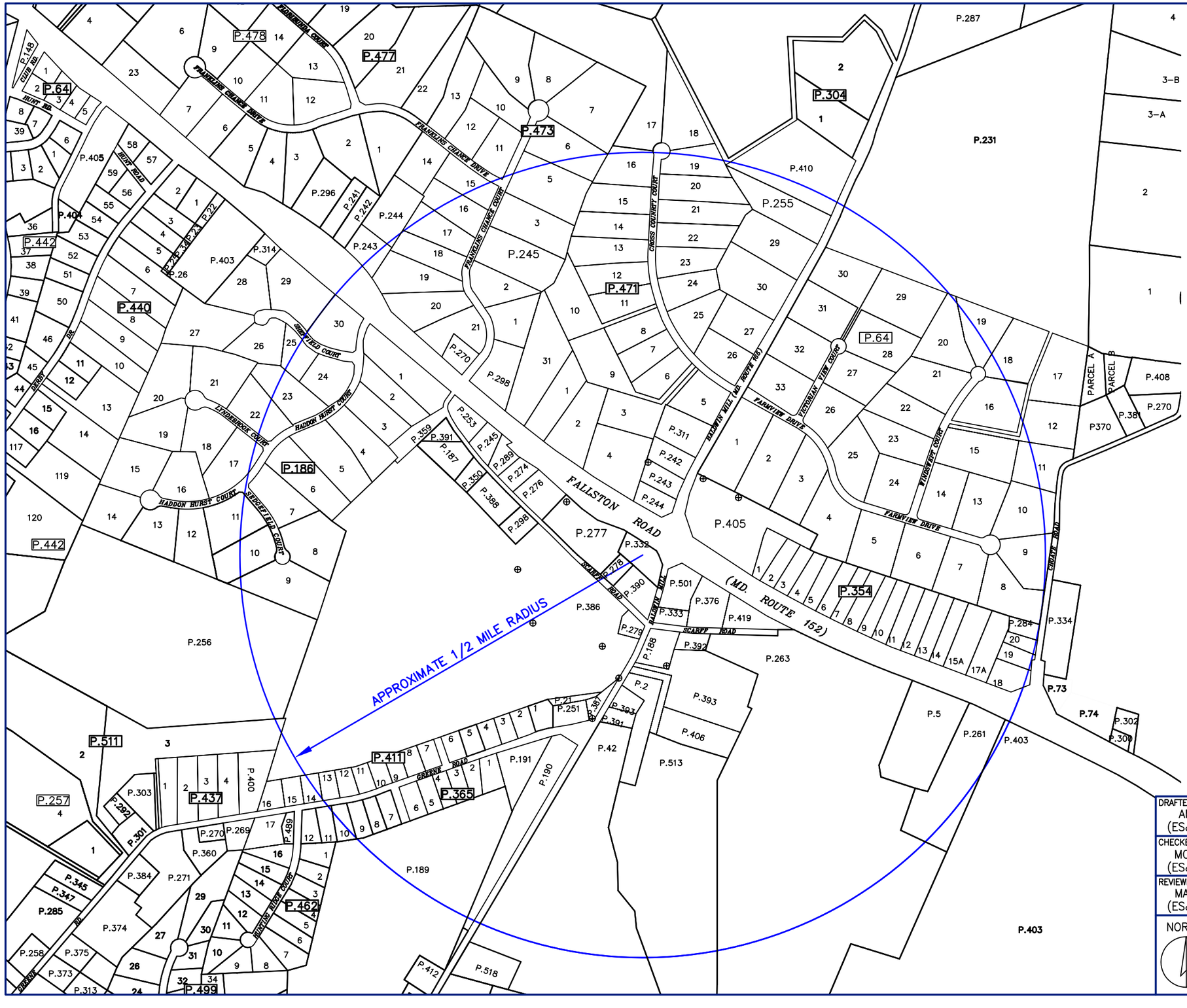
5.2 The geologic information compiled will be summarized and presented along with results, interpretations and implications for a practical site groundwater monitoring program. In addition, a three-dimensional visual model of hydrogeologic features at the service station, and a conceptual model of the area indicating potable well depths and known geological features will be developed.

The findings of the completed investigation will be summarized and presented in a report submitted to the MDE. The report will also include a detailed conceptual site model and will use the findings of the various field tests to directly support fate and transport analysis. This report may also serve as the basis for modification of the area-wide supply well monitoring program or for discontinuing monitoring at selected supply wells based on known contaminant flow path(s), well location and depth, other known sources and aquifer characteristics.

Table 1. 28329 Exxon Service Station, Fallston, MD

ID	Task Name
1	**Comprehensive Site Assessment**
2	**Non-Intrusive Study**
3	Non-Intrusive Investigations
4	GIS/GPS/Database
5	Well Completion Reports
6	**Access Agreements / Clear Vegetation**
7	**Overburden Investigation**
8	**Bedrock Aquifer Investigation**
9	Geophysical on Existing Wells
10	New Well Installation
11	Packer Testing
12	*Existing Wells*
13	*New Wells*
14	Pump Test/ Fluid Levels
15	**Data Interpretation**
16	**Report**
17	-Text, Figures, Boring Logs, Cross-sections
18	**Lab Results**





DRAFTED BY: AM (ES&T)	LOCAL AREA MAP OF PROPOSED MONITORING WELL LOCATIONS
CHECKED BY: MCS (ES&T)	EXXON SERVICE STATION #2-8329 2800 FALLSTON ROAD FALLSTON, MARYLAND
REVIEWED BY: MAP (ES&T)	Groundwater & Environmental Services, Inc. 2134 ESPEY COURT, SUITE 14, CROFTON, MD 21114
NORTH	SCALE IN FEET (APPROXIMATE): 0 650 / DATE: 7-14-04 / FIGURE: 1

FALLSTON ROAD

BALDWIN MILL ROAD (MD. RTE. 165)

EXXON SERVICE CENTER

24" RCCP

24" RCCP

12" PVC INFILTRATION OVERFLOW

12" PVC

18" RCCP

10" ø PERFORATED PVC PIPE

4" ø PERFORATED PVC PIPE

STORM WATER INFILTRATION DEVICE

OP (1)

OP (2)

OP (3)

CANOPY

MW1

MW2

MW3

MW4

TF1

TANK FIELD

VENT PIPES

SLOPE

SLOPE

SLOPE

GRASSY AREA

GRASSY AREA

DUMPSTER

HANDICAP PARKING

SHED

SVE BLOWER

FORMER PROPANE TANK PAD

TRAILER

GRANULAR ACTIVATED CARBON VESSELS

HYDRAULIC LIFT EXCAVATION AREA

CONCRETE RETAINING WALL

HEDGE ROW

1/2" BLACK POLY DISCHARGE PIPING

EXTRACTION SYSTEM COMPOUND

FORMER MAMA LIBERA'S

LEGEND

- OBSERVATION PIPE
- AIR PUMP
- TELEPHONE
- ELETRICAL SERVICE
- DRINKING WATER WELL
- DISPENSER ISLAND
- WASTE OIL AST
- KEROSENE AST
- CHAIN–LINK FENCE
- TRENCH DRAIN WITH SEDIMENT TRAP
- RIP–RAP CHANNEL
- ABANDONED MONITORING WELL
- FORMER OIL/WATER SEPARATOR
- FORMER 1,000–GAL WASTE OIL UST
- FORMER 1,000–GAL FUEL OIL UST
- STORM DRAIN MANHOLE
- STORM WATER OUTLET
- STORM WATER INLET
- STORM DRAIN INLET & ACCESS
- MONITORING WELL
- PROPOSED MONITORING WELL
- UNDERGROUND PIPING
- ABOVE GRADE PIPING

DRAFTED BY: AM (ES&T)

CHECKED BY: MCS (ES&T)

REVIEWED BY: MAP (ES&T)

NORTH

PROPOSED MONITORING WELL LOCATIONS

EXXON SERVICE STATION #2-8329
2800 FALLSTON ROAD
FALLSTON, MARYLAND

Groundwater & Environmental Services, Inc.
2134 ESPEY COURT, SUITE 14, CROFTON, MD 21114

SCALE IN FEET: 0 – 40

DATE: 7–14–04

FIGURE: 2